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The Determinants of Industrialisation in Developing Countries, 1960-2005

Francesca Guadagno[1]

Abstract

Industrialisation is generally considered a synonym of economic development. This paper contributes to the literature on the engine of growth hypothesis with an empirical analysis of the determinants of industrialisation. The paper goes back to the Cornwall (1977) model of manufacturing as an engine of growth and estimates the first equation of the model, i.e. the equation of manufacturing output growth. Hausman and Taylor models are estimated for a sample of 74 countries for the period 1960-2005. The results indicate that industrialisation is faster for larger countries with an undeveloped industrial base, strong export performance, and undervalued exchange rates. Skills and knowledge accumulation played an increasingly important role since the mid-1990s. Robustness checks corroborate the validity of these findings.

Keywords: industrialisation, manufacturing sector, technological change, industrial policy

JEL classification: O10, O14, O25

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[1] This paper is part of my PhD Dissertation. I thank my supervisor, prof. Bart Verspagen, for guidance and comments and prof. Jan Fagerberg for comments on an earlier draft.

1 Introduction

It is well-established that economic development is accompanied by processes of structural change, i.e. by shifts of production resources from low-productivity traditional sectors (e.g. agriculture) to high-productivity modern sectors (e.g. manufacturing and modern services). Owing to its higher capital intensity, its technological content and its stronger linkages with the rest of the economy, since early development economics manufacturing has been considered the engine of economic growth (e.g. Kaldor, 1957, 1966; Cornwall, 1977). Econometric evidence confirmed that accelerated growth of manufacturing output is associated with faster economic growth (e.g. Kaldor, 1967; UN, 1970; Cripps and Tarling, 1975; Fagerberg and Verspagen, 1999; Szirmai and Verspagen, 2015).

This paper analyses the long-term dynamics of industrialisation and investigates its determinants in a sample of 74 developed and developing countries from 1960 to 2005. The study goes back to the model of the engine of growth hypothesis (Cornwall, 1977). This model is made of two equations that posit that aggregate output growth depends on manufacturing output growth. Recent econometric estimations applied two-step instrumental variable techniques and instrumented manufacturing output growth with all the other exogenous variables of the model. This literature reports and discusses only the second step of the estimations – the results of the estimation of the equation of the aggregate output growth. The first step – the estimation of the equation of manufacturing output growth – is only used to feed into the second equation. This study looks at this first equation, before it feeds into the equation of economic growth. This means looking at what variables truly instrument for manufacturing growth when estimating the model of the engine of growth hypothesis with two-step instrumental variable techniques. By doing so, this paper not only contributes to the literature on the hypothesis of manufacturing as an engine of growth, but also to the academic and policy debate on industrialisation. By putting manufacturing at the core of the analysis, this study investigates how some countries industrialised, while others did not, and how the conditions for industrialisation have changed over time.

Recent empirical analysis also showed that in the last decades both manufacturing and modern services act as engines of economic growth (e.g. Felipe et al., 2009; Timmer and de Vries, 2008). In light of this empirical evidence, some scholars questioned the idea that industrialisation via manufacturing is still a necessary step towards development and proposed modern services as the new engine of economic growth (e.g. Dasgupta and Singh, 2005, 2006). While it is undeniable that in the last decades modern services have played an important role in the economy, this study adopts a long-term perspective and therefore looks only at the manufacturing industry.

The paper is structured as follows. The next section provides a literature review on the role and drivers of industrialisation. Section 3 presents our econometric model and describes the data used. Section 4 presents the results of the econometric estimations. Robustness checks are reported in section 5. Section 6 briefly concludes.

2 Literature review

In the early structural development economics, the term industrialisation referred to the process of structural change that backward countries experience in their development from agrarian to industrial urban economies (Clark, 1940; Kuznets, 1966; Cornwall, 1977). The positive relationship between economic growth and growth of the manufacturing industry was explained by some of the properties of manufacturing. It was argued that manufacturing is more productive and more capital intensive than the other industries (Hoffmann, 1958; Chenery et al., 1986). Because capital goods embody state-of-the-art technologies and learning accumulates with production, manufacturing is also considered the locus of technological progress (Cornwall, 1977). Finally, stronger backward and forward linkages to the rest of the economy characterise the manufacturing industry. Thanks to these stronger linkages, productivity growth in manufacturing spills over other industries, benefiting the whole economy (Rosenstein Rodan, 1943; Nurkse, 1953; Hirschman, 1958; Cornwall, 1977).

Based on this evidence, in his 1977 book, John Cornwall proposed a model of the engine of growth hypothesis, according to which economic growth depends on manufacturing output growth. Using data for market economies for the 1950s and 1960s, early empirical analysis confirmed that economic growth is significantly associated with manufacturing output growth (Kaldor, 1967; UN, 1970; Cripps and Tarling, 1975). More recently, Fagerberg and Verspagen (1999) and Szirmai and Verspagen (2015) verified the engine of growth hypothesis using more recent data and larger datasets. They show that manufacturing is still an engine of growth, provided that countries target the most dynamic manufacturing industries and possess enough absorptive capacity. Country case studies (e.g. Tregenna, 2007; Kuturia and Raj, 2009) also confirmed the importance of manufacturing for industrialisation.

The early structural development economics evolved into two approaches: the structural approach to development economics, represented by Hollis Chenery and his co-authors, and the Latin American structuralism. The structural approach to development economics focused on the role of trade and exports, arguing that trade openness and outward-oriented development strategies led to rapid export growth, fostering structural change (Chenery, 1960, 1975, 1980; Chenery et al., 1979, 1986; Syrquin, 1988). Latin American structuralism, instead, focused on the relationship between productive specialisation and balance of payment constraints. Inspired by the writings of Raul Prebisch (1950, 1973), Latin American structuralists argue that developing countries tend to specialise in primary commodities and resource-intensive industries, for which they have comparative advantages. However, this specialisation causes a decline in their terms of trade and constrains their balance of payments. [2] Dependency on primary commodities also makes developing countries vulnerable to volatile international commodity prices and to capital account shocks. This would often cause cyclical overvaluations of the exchange rate that penalise the manufacturing industry, frustrating countries' industrialisation efforts (see also Bresser-Pereira, 2008, 2012; Ocampo, 2011). Modern Latin American structuralism is giving increasing importance to innovation by incorporating views from the Schumpeterian approach (e.g. Katz, 2000, 2001; Cimoli and Katz, 2003; Astorga et al., 2014).

Schumpeterian (or evolutionary) economists have studied the role of innovation for economic growth and structural change. Their analyses demonstrate the importance of learning and capabilities' accumulation for industrialisation and show that international competitiveness is driven more by technological than cost competitiveness and that dynamic manufacturing industries drive economic growth more than growth in other sectors (e.g. Fagerberg, 1988, 1996, 2000; Fagerberg and Verspagen, 1999, 2002; Fagerberg et al., 2007; Szirmai and Verspagen, 2015). These findings were also corroborated by the experience of the East Asian NIEs that industrialised thanks to their efforts in technology adoption and capabilities' accumulation (e.g. Kim, 1992, 1997; Nelson and Pack, 1999; Lall, 2004; Lee and Lim, 2001; Lee, 2009).

3 Approach and overview of the data

Approach

This paper empirically tests the first part of the Cornwall (1977) model of the engine of growth hypothesis. Two main equations compose the model:

$$\dot{Q}_m = g_0 + g_1\dot{Q} + g_2 q + g_3 q_r + g_4 (I/Q)_m$$

$$\dot{Q} = e_0 + e_1\dot{Q}_m$$

The first equation explains the output growth in manufacturing and the second the aggregate output growth rate. That the growth of output depends on the rate of growth of manufacturing output is reflected in the coefficient, e_1, which measures of the power of manufacturing as an engine of growth. The determinants of the growth rate of manufacturing output, $\dot{Q}_m$, are the level and growth rate of aggregate income, income relative to the most developed economies, and investment. The level of income is introduced to take into consideration that when per capita income raises consumption shifts from manufactured goods to services (Baumol, 1967). A feedback from demand growth is introduced

[2] A similar argument was made by Singer (1950).

via the income growth rate. The ratio of per capita income compared with that of high-income countries captures the size of the technology gap: the larger the gap with the technological frontier, the greater the amount of technology that an industrialising country can borrow, and so the higher the rate of industrialisation. Investments measure the efforts to develop imported and indigenous technologies.

This paper empirically tests a revised version of the first equation of this model – the equation of manufacturing output growth. This revised version of the model builds on previous estimations of the Cornwall model (Kaldor, 1967; UN, 1970; Cripps and Tarling, 1975; Fagerberg and Verspagen, 1999; Szirmai and Verspagen, 2015). To capture manufacturing output growth, we use the first difference of the share of manufacturing in GDP. As suggested by Cornwall (1977), the level and growth rate of aggregate income should not be simultaneously included in estimations because the simultaneous inclusion of variables containing income could create collinearity. Therefore, only the income relative to the most developed economy (US) is included in the model. Together with income relative to the US, we include the lagged value of the manufacturing share in GDP to account for catch up or cumulativeness in the industrialisation process. We expect the coefficients of these two variables to be negative. Because the level of investment is endogenous to manufacturing growth, it is accounted for by the variables that drive it in the first place (among the others, we also include terms of trade and inflation).

Following previous estimations of the model of the engine of growth hypothesis (Fagerberg and Verspagen, 1999; Szirmai and Verspagen, 2015), we augment the original model by adding the labour costs, skills, and capabilities to account for supply-side factors, and the size of the domestic and export markets to account for demand-side factors. Labour costs are a measure of international competitiveness: higher labour costs make exports more expensive and countries less competitive. According to the Kaldor paradox (Kaldor, 1978), rapidly growing countries are characterised by high growth rates of labour costs. This suggests that labour costs cannot be the sole determinant of industrialisation in the long run. Moreover, depending on countries' industrial specialisations, low wages can be explained by low productivity, and therefore lower competitiveness. Despite this might vary across industries, we expect that the overall effect of labour costs on industrialisation is negative (Amable and Verspagen, 1995).

Empirical studies in the evolutionary tradition showed that price competitiveness is not the most important determinant of international competitiveness in the long run. Instead, skills and technological capabilities are more important (Fagerberg, 1988; Amendola et al., 1993; Fagerberg et al., 2010; Fagerberg and Verspagen, 1999; Szirmai and Verspagen, 2015). In this study, traditional measures of education levels account for skills' accumulation (Barro and Lee, 2010). Patents and R&D expenditures measure technological capabilities. In a first stage, we use the number of USPTO patents per capita. Due to its clear advantages in terms of data availability and cross-country comparability, this is the most widely used indicator in the literature. However, USPTO granting procedures require a high degree of novelty of the patented invention. These requirements are likely to be excessive in developing countries' contexts. Therefore, in a second stage, we use depreciated USPTO patent stock, the number of patent per capita at national offices (granted to residents), R&D expenditures, and a measure of technological level developed by Fagerberg (1988). National patent offices' criteria to grant patents are less stringent than the USPTO are, allowing capturing a much broader range of innovations. In contrast with patents that represent the output of innovation processes, R&D expenditures are an indicator of innovation input. For this reason, R&D expenditures and patents can be considered complementary measures of innovation. This is why Fagerberg (1988) combines them in a single indicator, the indicator of technological level.

With respect to demand-size factors, population size accounts for the size of the domestic market. The size of the external market is captured by merchandise exports as percentage of GDP. Among other variables, the size of exports' markets depends on exchange rates: by making the price of tradable goods higher relative to that of non-tradable, undervalued exchange rates encourage the transfer of resources towards the more profitable tradable sector. Since the tradable sector is mainly made of industrial activities, the effect of the real exchange rate on growth is channelled by industrialisation. To account for real exchange rates, we use the undervaluation index proposed by Rodrik (2008). This index, taken in logarithmic form, is positive when the currency is undervalued.

Following previous studies (Fagerberg and Verspagen, 1999; Rodrik, 2008), we also account for institutional and macroeconomic factors. With respect to institutions, in the literature there is broad consensus that institutions matter for growth. This paper tests if institutions affect growth via industrialisation. The indicators of institutions used in the literature mainly capture political systems variables, such as democracy index and rule of law. Fagerberg and Schrolec (2008) demonstrated that good governance contributes to economic growth more than democratic political systems. However, indicators of good governance are not available for long time series. In order to preserve the length of our panel, we chose to rely on indicators of political systems. Our preferred measure of institutions is the Vanhanen index (Vanhanen, 2000). Compared to other measures (e.g. Polity and Freedom House data), this indicator uses quantitative data, rather than subjective evaluations.

We also include a variable that accounts for the portion of land in temperate climatic zones. Geographical variables are the classic instruments in empirical studies on economic growth. While institutions and trade are endogenous because they are mutually determined and in turn influenced by economic growth, geography is considered an exogenous determinant of economic growth, making it a good instrument in this type of empirical analysis (e.g. Acemoglu et al., 2001; Dollar and Kraay, 2003; Rodrik et al., 2004; Lee and Kim, 2009).

Description of the data

Our dataset is an unbalanced panel of 74 developed and developing countries covering the period 1960-2004. Details on the sources and definitions of the explanatory variables are provided in Table 8 of Appendix 1. Details on the countries covered by this study are provided in Table 9 in Appendix 1. Table 1 presents descriptive statistics of the variables used.

Table 1. Descriptive statistics

Variable	Mean	Standard Deviation			Observations		
		Overall	Between	Within	N	n	T-bar
First difference of the manufacturing share in GDP	0.10	2.30	1.30	2.73	613	85	7.2
Lagged value of the manufacturing share in GDP (MANL1)	18.27	8.06	7.48	3.99	645	85	7.6
GDP per capita as a percentage of US GDP (RELUS)	0.31	0.28	0.28	0.07	734	85	8.6
Wage (WAGE)	7.99	1.26	1.02	0.81	559	80	6.9
Population (LNPOP)	9.32	1.64	1.63	0.28	758	85	8.9
Merchandise exports (EXPORT)	0.23	0.17	0.15	0.09	712	84	8.5
Undervaluation index (UNDERVAL)	0.05	0.46	0.37	0.30	706	85	8.3
Democracy index (DEM)	14.32	13.68	12.33	5.98	699	84	8.3
Education (EDU)	5.59	2.78	2.48	1.37	751	85	8.8
Terms of trade (TOT)	0.00	0.10	0.08	0.07	729	85	8.6
Inflation (INFL)	2.20	1.08	0.74	0.82	661	83	8.0
USPTO patents per capita (PATPC)	0.07	0.18	0.17	0.06	715	82	8.7
Depreciated stock of USPTO patents (PATSTOCK)	0.09	0.28	0.27	0.09	753	84	9.0
National offices' patents per capita (NATPATPC)	0.10	0.19	0.15	0.09	455	72	6.3
R&D expenditures (R&D)	0.25	0.27	0.26	0.07	307	63	4.9

The table shows that the within component of the standard deviation of the dependent variable (the first difference of the share of manufacturing in GDP) is larger than its between component. The opposite is true for all the explanatory variables except for inflation (due to its high volatility). Because the variation in the data is mainly between rather than within countries, we would not rely on fixed effect models which look at within countries variations and wipe out between effects. Moreover, because our objective is to understand why some countries industrialised and others did not, we are interested in between countries variations rather than within countries variations.

As Table 1 shows, data on R&D expenditures are limited because they start in 1980. This significantly reduces the length of our dataset and leads us to prefer patent indicators, whose data start in the 1960s. Patent indicators and R&D expenditures are generally highly correlated, albeit the correlation is lower for some regions than are for others. For example, the correlation between USPTO patents and R&D expenditures is 0.86 for the whole sample, 0.62 for Africa, and only 0.31 for Latin America. Similarly, the correlation between USPTO and national offices' patents is 0.74 for the whole sample, 0.84 for Africa, and 0.20 for Latin America. Given these high correlations, the use of both these indicators can be justified.

Before delving into the econometric analysis, it is worthwhile noting that several countries in our sample did not industrialise, i.e. they have not yet become rich industrial countries. Felipe et al. (2014) found high correlation coefficients between being an industrialised, i.e. rich, country today and having experienced a peak in manufacturing employment share higher than 18-20% and a peak in manufacturing share in GDP higher than 22% between 1970 and 2010.[3] Roughly speaking, a country could be defined industrialised if its share of manufacturing in GDP surpassed the threshold of 22%.[4] By applying this rule to our sample, we find that 40 countries out of 74 reached the peak of 22%, or higher, in manufacturing shares in GDP between 1960 and 2005.

4 Results

We begin our econometric analysis by comparing fixed and random effects, between, and Hausman and Taylor (1981) specifications. Following Jacob and Osang (2007) and Szirmai and Verspagen (2015), we separately inspected each explanatory variable by means of Hausman tests (not reported here) in order to identify endogenous explanatory variables. The lagged share of the manufacturing share in GDP, the undervaluation index, and population are endogenous.[5] Because the lagged dependent variable is included in all these models, fixed effects models are biased (Nickell, 1981). Similarly, the Hausman and Taylor models are also likely to be biased, since they partly rely on within transfor-

[3] A rich country is defined as a country whose average per capita GDP during 2005–2010 exceeds a cutoff of $12,000 in 2005 prices (not PPP corrected). This roughly corresponds to the World Bank's definition of a high-income economy.
[4] Felipe et al. (2014) show that employment shares are better predictors of GDP today, than output shares. Nevertheless, due to data availability and in line with our definition of industrialisation, we look at output shares rather than employment shares.
[5] As a first robustness check, we estimate a Hausman and Taylor model where we follow existing empirical evidence to determine which variables are endogenous. We treat lagged manufacturing shares, exports, wages, education, patents, and the democracy index as endogenous explanatory variables. Results (not reported here) do not vary and the p-value of the test of over-identifying restriction is 0.8061, which would confirm that the Hausman and Taylor specification is consistent and the most efficient.

mations. For this reason, Section 2.5 reports a number of robustness checks, including system GMM estimations that solve the dynamic panel bias. Results are reported in Table 2.

Table 2. Determinants of industrialisation, 1960-2005

	Fixed effects			**Random effects**			**Between**			**Hausman and Taylor**		
	coef	se	sig	coef	se	sig	coef	se	sig	coef	se	sig
manL1 #	-0.385	0.049	***	-0.182	0.027	***	-0.052	0.041		-0.349	0.033	***
population #	3.786	1.456	*	0.358	0.124	**	0.086	0.142		1.493	0.599	*
undervaluation #	1.655	0.821	*	1.484	0.574	**	0.786	0.700		1.925	0.570	***
export	8.440	2.487	**	5.448	1.550	***	5.009	1.773	**	8.170	1.806	***
relus	0.620	2.839		-2.779	1.377	*	-0.029	1.993		-1.317	2.387	
wage	0.417	0.294		0.084	0.234		-0.841	0.398	*	0.343	0.306	
edu	0.249	0.346		0.141	0.094		0.022	0.126		0.354	0.220	
democracy	-0.024	0.030		-0.021	0.020		-0.059	0.029	*	-0.019	0.024	
patents	-1.362	2.445		-0.110	1.109		0.346	1.886		-1.456	2.062	
inflation	0.306	0.189		-0.062	0.158		0.077	0.235		0.287	0.162	+
terms of trade	3.207	2.466		2.103	1.518		-1.216	2.820		3.221	2.004	
kgatemp				1.479	0.486	**	1.455	0.589	*	1.602	1.740	
D65-70	-0.501	0.633		-0.069	0.678		-2.067	4.079		-0.328	0.539	
D70-75	-2.918	0.624	***	-1.733	0.529	**	-0.502	3.971		-2.586	0.604	***
D75-80	-3.950	0.938	***	-1.864	0.710	**	3.001	4.441		-3.269	0.733	***
D80-85	-5.176	1.182	***	-2.450	0.767	**	-8.036	5.267		-4.312	0.905	***
D85-90	-5.468	1.343	***	-2.486	0.714	***	3.886	4.977		-4.557	0.992	***
D90-95	-5.757	1.553	***	-2.549	0.777	**	-0.736	2.992		-4.671	1.127	***
D95-00	-7.532	1.803	***	-4.076	0.768	***	0.350	3.023		-6.303	1.238	***
D00-05	-7.790	1.936	***	-3.882	0.765	***	-2.180	2.656		-6.475	1.365	***
constant	-31.216	13.606	*	0.598	2.063		6.785	4.165		-10.509	5.987	+
Rho	0.849			0.075						0.881		
Obs	435			435			435			435		
Countries	74			74			74			74		
R2 within	0.334			0.289			0.002					
R2 between	0.041			0.418			0.608					
R2 overall	0.047			0.316			0.031					

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Notes: Standard errors for fixed and random effects are robust (adjusted for clusters). The # indicates the variables that were treated as endogenous in Hausman and Taylor.

The results of the fixed effects, random effects, and Hausman and Taylor estimations are quite similar, while the between estimation seems to tell a different story. In the fixed effects, random effects, and Hausman and Taylor estimations, lagged manufacturing shares, population size, export shares, and exchange rates are significant determinants of industrialisation. In countries with less developed manufacturing industries, manufacturing grows faster, meaning that there is catch-up in industrialisation. The size of the domestic market, export shares, and the undervaluation index are related positively and significantly to industrialisation. This confirms existing empirical evidence on the role of exports and undervalued exchange rates. Wages are positively and not significantly associated with industrialisation. The coefficient of income relative to the US is most of the times negative and significant only in the random effects estimation. The coefficient of education is positive but never significant. The number of the USPTO patents is negatively but not significantly associated with manufacturing growth. With respect to macroeconomic factors, the coefficients of the inflation rate are positive in all estimations but in random effects, and significant only in the Hausman and Taylor estimation. This suggests that inflation control is not a necessary element of industrial development strategies. Terms of trade are usually positive, but never significant. Finally, the coefficients of all the period dummies but the first are negative and highly significant. This suggests that industrialisation has become increasingly difficult to achieve. A significance test on whether these coefficients are statistically different from each other indicates that dummies from the 1980s until the 1990s and the dummies for 1995 and 2000 are not statistically different, suggesting that these periods have some commonalities.

The story that emerges from the between estimation is quite different. Because the between model transforms explanatory variables into country means, these estimations exploit the pure cross-country dimension of the data. These results suggest that between countries differences in industrialisation are explained by exports, labour costs, institutions and geography. As expected, countries with higher export shares, lower labour costs, and in temperate climatic zones experience faster manufacturing growth. Less democratic countries, however, industrialise faster. It is worth noting that the coefficient of the institutional indicator is always negative and becomes significant only in the between specification. We further test for the role of institutions by using alternative indexes (see Table 10 in Appendix 2). Because the results confirm that broadly defined institutions are never significant determinants of industrialisation, we decide to omit democracy indexes from the rest of the analysis.

The Hausman test of over-identifying restrictions strongly rejects (p= 0.0000) the null hypothesis of consistency of the random effects model. The same test performed for the Hausman and Taylor specification does not reject the null hypothesis (p= 0.9645), i.e. the Hausman and Taylor specification is both consistent and efficient. Therefore, the Hausman and Taylor model is our preferred model. This combines the advantages of fixed and random effects models because it deals with endogeneity and does not eliminate country time-invariant effects.

Table 3 reports Hausman and Taylor estimations where we test for four alternative measures of technological change, namely the depreciated USPTO patent stock (column 1); patents at national patent offices (column 2); R&D expenditures as a percentage of GDP (column 3); and the indicator of technological level developed by Fagerberg (1988) (column 4). Hausman tests indicate that these four variables are exogenous. Because R&D and secondary education are too closely related, education was dropped in column 3 and 4.

Table 3. Alternative measures of technical change

	Patent Stock			**National patents**			**R&D**			**Technological Level**		
	coef	se	sig	coef	se	sig	coef	se	sig	coef	se	sig
manL1	-0.349	0.034	***	-0.380	0.040	***	-0.490	0.056	***	-0.484	0.055	***
population	1.447	0.585	*	1.064	0.655		1.553	0.990		1.757	1.116	
undervaluation	2.006	0.568	***	2.736	0.766	***	2.873	0.774	***	2.395	0.714	***
export	8.380	1.814	***	8.396	2.139	***	9.678	2.176	***	10.281	2.168	***
relus	-1.836	2.293		0.904	2.474		1.358	3.673		2.666	4.038	
wages	0.319	0.306		0.084	0.394		-0.263	0.365		-0.248	0.357	
edu	0.353	0.219		0.510	0.252	*						
innovation	-1.980	3.481		0.085	1.610		3.329	1.856	+	3.017	3.942	
inflation	0.259	0.162		0.382	0.170	*	0.355	0.187	+	0.324	0.186	+
terms of trade	3.302	2.002	+	3.103	3.235		-9.017	4.457	*	-9.604	4.016	*
kgatemp	1.508	1.661		0.517	1.653		0.422	2.397		0.163	2.791	
D65-70	-0.358	0.538		0.425	0.693							
D70-75	-2.600	0.602	***	-2.372	0.737	**						
D75-80	-3.236	0.733	***	-3.190	0.857	***						
D80-85	-4.271	0.904	***	-4.162	1.058	***	1.680	0.669	*	1.683	0.665	*
D85-90	-4.604	0.983	***	-4.331	1.135	***	1.521	0.612	*	1.685	0.601	**
D90-95	-4.762	1.112	***	-4.568	1.264	***	1.566	0.556	**	1.757	0.543	**
D95-00	-6.404	1.223	***	-5.812	1.370	***	0.395	0.444		0.401	0.433	
D00-05	-6.661	1.347	***	-6.692	1.509	***						
Constant	-9.926	5.882	+	-6.103	6.681		-9.721	10.653		-12.011	11.976	
Rho	0.869			0.877			0.913			0.943		
Obs	432.000			321			238			241		
Countries	72.000			62			58			58		

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

The stock of USPTO patents is negatively associated with industrialisation, while the other three indicators are positively associated with industrialisation. Only the coefficient of R&D expenditures is significant. This confirms how difficult it is to measure technological efforts in industrialising countries. The introduction of alternative measures of innovation does not affect the other results, but makes education significant in column 2.

We now test if, and, how the behaviour of the determinants of industrialisation evolved over time. According to the data, between 1960 and 1975 the share of manufacturing in GDP increased in the developing world, but decreased in developed countries. After 1975, only Asia continued to industrialise, while Africa and Latin America started to deindustrialise (Szirmai, 2012). In order to check how the behaviour of the determinants of industrialisation changed over time, we aggregate the nine time dummies into three sub-periods: 1960-1975, 1975-1990, and 1990-2005. These slope dummies are interacted with all the explanatory variables. We estimate three models: the base model (column 4 of Table 2), a model with R&D expenditures, and one with the Fagerberg (1988) indicator of technological level. As in previous estimations, the introduction of R&D expenditures and technological level reduces the length of panel to the period 1980-2005. Moreover, when these two variables are included, education is dropped due to potential collinearity. Results are reported in Table 4.

Table 4. Estimations for three periods: 1960-75, 1975-90, 1990-2005

	Base model			R&D			Technological Level		
	coef	se	sig	coef	se	sig	coef	se	sig
manL1_60_75	-0.367	0.067	***						
manL1_75_90	-0.330	0.049	***	-0.377	0.063	***	-0.373	0.064	***
manL1_90_05	-0.427	0.050	***	-0.602	0.066	***	-0.597	0.066	***
pop_60_75	1.168	0.395	**						
pop_75_90	1.032	0.369	**	0.720	0.711		1.063	1.001	
pop_90_05	0.962	0.343	**	0.960	0.682		1.277	0.987	
underval_60_75	0.581	1.027							
underval_75_90	0.844	0.726		0.667	0.980		0.744	0.964	
underval_90_05	3.084	1.037	**	3.859	1.256	**	3.947	1.290	**
relus_60_75	-3.393	3.110							
relus_75_90	-5.327	2.928	+	-2.430	3.981		-2.265	4.436	
relus_90_05	-5.672	2.541	*	-2.270	3.774		-1.541	4.246	
wage_60_75	1.109	0.831							
wage_75_90	0.484	0.504		-0.148	0.567		-0.122	0.564	
wage_90_05	0.906	0.391	*	0.300	0.425		0.451	0.423	
exp_60_75	8.673	3.415	*						
exp_75_90	5.999	2.451	*	6.345	3.061	*	6.696	3.035	*
exp_90_05	7.533	1.766	***	11.319	2.248	***	11.938	2.268	***
edu_60_75	0.492	0.246	*						
edu_75_90	0.355	0.227							
edu_90_05	0.134	0.199							
tot_60_75	3.340	2.328							
tot_75_90	1.209	3.365		-9.925	4.921	*	-9.861	4.957	*
tot_90_05	4.677	4.224		-2.608	6.417		-1.692	6.438	
infl_60_75	1.289	0.388	***						
infl_75_90	0.173	0.216		0.414	0.225	+	0.373	0.227	+
infl_90_05	-0.094	0.230		0.179	0.236		0.161	0.235	
patpc_60_75	-2.137	2.710							
patpc_75_90	-0.258	2.868							
patpc_90_05	2.619	2.296							
rd_75_90				3.324	2.205				
rd_90_05				5.049	2.045	*			
TL_75_90							6.589	4.311	
TL_90_05							7.006	4.064	+
kgatemp	2.123	1.118	+	1.410	2.224		1.146	2.560	
Constant	-14.958	7.066	*	-4.532	7.726		-5.092	11.162	
Rho		0.685			0.901			0.928	
Obs		442			238			236	
Countries		75			58			57	

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Notes: Period dummies are included but not reported in the table.

Four interesting results emerge from these estimations. First, the coefficients of the lagged manufacturing and exports are the only two variables that are consistently significant in all sub-periods. The signs of their coefficients confirm previous findings. The coefficients of the export shares show that exports were particularly important in the period from 1960 to 1975 and from 1990 to 2005. Second, the coefficient of the undervaluation index is significant only in the last period (1990-2005). Its significance and higher coefficient indicate that exchange rate management became more important from the 1990s. Third, income relative to the US, which was rarely significant in previous estimations, becomes significant from the mid-1970s (column 1). Its negative sign confirms the presence of catch-up forces in industrialisation. Finally and most importantly, the coefficient of USPTO patents per capita, negative in previous estimations, becomes positive (although not significant) in the last period. This suggests a more prominent role of technological change in modern industrialisation efforts. In column 2 and 3, where R&D expenditures and technological level substitute for USPTO patents, the coefficient of both R&D expenditures and technological levels are always positive and significant in the period from 1990 and 2005. Therefore, these estimations confirm that accumulation of technological capabilities became increasingly important in the last two decades.

5 Robustness checks

Our estimations might be affected by endogeneity. Although this was already addressed by Hausman and Taylor estimations and by preserving the length of the panel, this section further verifies the validity of our results by using General Methods of Moments (GMM) and mixed effects estimations. Because USPTO patents did not turn out to be a significant determinant of industrialisation and other measures of technical change severely reduce the length of the panel, we exclude innovation measures from the next estimations.

Table 5 reports OLS and fixed effects estimations in column 1 and 2 respectively. In columns 3-5, results of three different specifications of system GMM models are reported. Roodman (2006) suggests that for a correct implementation of system GMM a panel must be characterised by small T and large N and the model should include time dummies (which is our case). The standard treatment of endogenous variables is to use lag 2 and deeper for the transformed equation and lag 1 for the levels equation. Moreover, the number of instruments must not exceed the number of groups, as this would weaken the Hansen tests. The p-value of the Hansen test must be higher than 0.1 and lower than 0.25, and the AR(2) above 0.1. Roodman (2009) proposes three solutions in the case of instrument proliferation and weak tests: limiting the set of instruments to certain lags, collapsing the instrument set, and combining the two former solutions.

Following Roodman (2006, 2009), model (1) in column 3 instruments all endogenous variables (the lagged value of manufacturing, population, and the undervaluation index) with lags 2 and deeper for the transformed equation and lag 0 in differences for the levels equation. Because the number of instruments becomes too high, model (2) in column 4 reduces the number of instruments by collapsing them.5 In model (3) of column 5, we adopt another strategy suggested by Roodman (2009). We reduce the number of instruments by using only some lags instead of the full set of available lags. We take lags 2-5 of the lagged dependent variable for the first difference equation and lag 0 in differences for the levels equation. The other two endogenous variables (population and undervaluation) are instrumented by lag 2 for the transformed equation and lag 0 in differences for the levels equation. This is the maximum number of instruments that we can include without exceeding the number of countries. At the end of the table, we report the number of observations, countries and instruments, the p-value of the test for autocorrelation of order 2 and the p-value of the Hansen test.

Table 5. System GMM

	OLS			**Fixed Effects**			**System GMM (1)**			**System GMM (2)**			**System GMM (3)**		
	Coef	se	sig	coef	se	sig	coef	se	sig	coef	Se	sig	coef	se	sig
manL1	-0.157	0.022	***	-0.381	0.039	***	-0.222	0.054	***	-0.168	0.088	+	-0.214	0.074	**
population	0.304	0.093	**	3.680	1.330	**	1.106	0.521	*	0.683	1.043		0.692	0.396	+
underval.	1.357	0.427	**	1.786	0.615	**	2.454	0.992	*	1.671	1.133		2.049	1.086	+
export	4.851	1.018	***	8.522	2.013	***	9.066	3.082	**	6.839	4.957		6.626	2.184	**
relus	-3.236	1.099	**	-0.365	2.625		-4.651	1.821	*	-4.004	2.756		-4.720	2.023	*
wages	0.017	0.228		0.387	0.336		0.755	0.471		0.346	0.429		0.427	0.284	
edu	0.105	0.081		0.291	0.292		0.223	0.094	*	0.150	0.241		0.255	0.130	+
inflation	-0.154	0.128		0.290	0.177		-0.052	0.198		0.077	0.184		-0.019	0.281	
tot	1.676	1.505		3.326	2.201		2.655	2.277		0.869	2.221		1.462	2.276	
kgatemp	1.152	0.382	**				1.321	0.521	*	1.181	0.517	*	1.469	0.567	*
D65-70	-0.044	0.601		-0.559	0.589		-0.146	0.898		0.136	0.770		0.027	0.724	
D70-75	-1.570	0.612	*	-2.995	0.682	***	-1.773	0.713	*	-1.731	0.781	*	-1.469	0.683	*
D75-80	-1.595	0.649	*	-3.975	0.878	***	-2.496	0.843	**	-2.511	1.081	*	-1.968	0.829	*
D80-85	-2.113	0.702	**	-5.223	1.100	***	-3.412	1.055	**	-2.799	1.564	+	-3.173	0.928	**
D85-90	-2.187	0.711	**	-5.663	1.208	***	-4.151	1.113	***	-3.105	1.652	+	-3.421	0.884	***
D90-95	-2.296	0.762	**	-6.029	1.387	***	-4.455	1.247	***	-3.945	1.913	*	-3.882	1.069	***
D95-00	-3.839	0.778	***	-7.857	1.551	***	-6.108	1.303	***	-5.127	2.213	*	-5.361	1.209	***
D00-05	-3.604	0.821	***	-8.184	1.701	***	-6.434	1.472	***	-5.088	2.624	+	-5.639	1.351	***
Constant	1.417	1.846		-30.298	12.479	*	-10.986	7.672		-4.730	12.275		-4.837	4.381	
Obs		435			435			435			435			435	
Countries		74			74			74			74			74	
Instruments								148			43			64	
AR(2)								0.385			0.435			0.391	
Hansen test								1.000			0.416			0.195	

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Notes: All GMM estimations are two-step estimations with Windmeijer correction.

OLS and fixed effects estimations define the credible range for the coefficient of the lagged value of the manufacturing share between -0.157 and -0.381. When we use all possible lags (column 3), the p-value of the Hansen test is 1.000. This is a tell-tale sign that the Hansen test is weak. The coefficient of lagged manufacturing share is highly significant as in all previous estimations and falls within the credible range. All previous results are largely robust, with RELUS and education becoming significant. By collapsing instruments (model 2), the number of instruments drops from 130 to 41. The p-value of the Hansen test decreases considerably (from 1.000 to 0.367), but is still not in the range suggested by Roodman (2006). The coefficient of lagged manufacturing is in the credible range but it is not significant. Export shares, kgatemp, and the time dummies are the significant explanatory variables. In model 3, the p-value of the Hansen test is 0.223 and the AR(2) is above 0.1 (0.393), both values therefore fall within the ranges suggested by Roodman (2006). The lagged value of manufacturing is significant and falls within the credible range. As in previous estimations, the undervaluation index and the share of exports are significant and positive. The coefficients of relus and wages are also significant, with the former being negatively associated with industrialisation (as expected) and the latter positively associated with industrialisation (as in previous estimations). The other results are largely confirmed.

We now check if mixed linear models would confirm or add on to our results. Mixed linear models permit random parameter variation to depend on observable variables; that is, allow explanatory variables to have a different effect for each country. Here we apply a random slopes model in which not only the intercept (as in a random effect model) but also the coefficients of some variables are allowed to change across countries. We estimate random slopes model, allowing one single variable at a time to have a random coefficient. We repeated this procedure for each single explanatory variable and we did not impose restrictions on the correlation of the random effects, i.e. we did not assume that they are uncorrelated. For every estimation we check the p-value of the LR test and retain only the models for which the LR test rejects the null hypothesis (the null hypothesis being that all the parameters are equal to zero so that adding random slopes does not add information to the random intercept model). Table 6 reports the estimations' results of these mixed effects models.

Table 6. Mixed effects models

	Random intercept			Random coefficient: Export			Random coefficient: Pop		
	coef	Se	sig	coef	se	sig	coef	se	sig
manL1	-0.178	0.023	***	-0.225	0.024	***	-0.196	0.024	***
population	0.356	0.103	***	0.452	0.105	***	0.451	0.115	***
undervaluation	1.453	0.435	***	1.566	0.429	***	1.498	0.443	***
relus	-3.233	1.169	**	-3.115	1.162	**	-3.058	1.168	**
wage	0.056	0.234		0.162	0.227		0.082	0.230	
export	5.348	1.093	***	6.995	1.700	***	5.967	1.082	***
edu	0.119	0.088		0.165	0.083	*	0.116	0.085	
inflation	-0.099	0.130		0.025	0.125		-0.086	0.131	
terms of trade	2.058	1.562		1.039	1.534		1.904	1.553	
kgatemp	1.273	0.424	**	1.422	0.398	***	1.204	0.415	**
D65-70	-0.084	0.574		-0.066	0.547		-0.066	0.570	
D70-75	-1.702	0.589	**	-1.784	0.560	**	-1.709	0.585	**
D75-80	-1.773	0.632	**	-2.068	0.604	***	-1.838	0.628	**
D80-85	-2.339	0.695	***	-2.826	0.670	***	-2.444	0.692	***
D85-90	-2.437	0.707	***	-2.951	0.680	***	-2.541	0.702	***
D90-95	-2.535	0.763	***	-3.171	0.733	***	-2.620	0.755	***
D95-00	-4.085	0.782	***	-4.680	0.750	***	-4.193	0.772	***
D00-05	-3.890	0.829	***	-4.605	0.799	***	-4.091	0.820	***
constant	0.838	1.911		-0.537	1.911		-0.038	1.944	
Random part									
sd (constant)	0.563	0.238		1.285	0.438		3.843	1.310	***
sd(residual)	2.301	0.089	***	2.181	0.082	***	2.277	0.088	***
sd(variable)				7.991	1.988	***	0.362	0.126	**
Obs		435			435			435	
Countries		74			74			74	

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Results show that adding random slopes for all variables, except for export shares and the size of the population, does not add information (the standard LR test accepts the null hypothesis that all the parameters are equal to 0). Lagged manufacturing shares, size of the domestic market, undervaluation and export shares are persistent determinants of industrialisation. According to these estimations, also income relative to the US is significantly related to industrialisation. Coefficients on period dummies confirm that industrialising became more and more difficult over time.

We also test for an alternative definition of industrialisation, the growth rate of the manufacturing share in GDP. As in Table 2, we report four estimations: fixed effects, random effects, between estimation, and Hausman and Taylor model. As in previous estimations, we check which variables are endogenous. Hausman tests suggest that together with the lagged share of manufacturing, population size and the undervaluation index are endogenous.

Table 7. Alternative dependent variable: growth rate of the manufacturing share in GDP

	Fixed effects			Random effects			Between			Hausman and Taylor		
	coef	se	Sig	coef	se	sig	coef	se	sig	coef	se	sig
manL1#	-0.023	0.003	***	-0.015	0.003	***	-0.004	0.003		-0.021	0.002	***
population#	0.110	0.141		0.030	0.011	**	0.007	0.012		0.061	0.027	*
undervaluation#	0.138	0.055	*	0.082	0.051		-0.005	0.056		0.135	0.041	**
wage	0.078	0.037	*	0.027	0.021		-0.089	0.032	**	0.062	0.021	**
relus	-0.062	0.245		-0.173	0.119		0.041	0.162		-0.160	0.149	
exports	0.406	0.185	*	0.310	0.111	**	0.187	0.142		0.417	0.121	***
edu	0.042	0.031		0.003	0.006		-0.004	0.010		0.016	0.012	
patents	0.024	0.126		0.036	0.082		0.101	0.154		-0.020	0.137	
democracy	-0.001	0.002		-0.001	0.001		-0.001	0.002		-0.001	0.002	
inflation	0.029	0.013	*	0.008	0.011		0.010	0.019		0.022	0.011	*
terms of trade	0.362	0.293		0.317	0.176	+	0.112	0.232		0.361	0.140	*
kgatemp				0.073	0.030	*	0.053	0.047		0.067	0.071	
oil				0.010	0.037		0.011	0.062		-0.038	0.108	
D65-70	-0.023	0.044		0.018	0.052		0.110	0.328		-0.003	0.039	
D70-75	-0.200	0.044	***	-0.107	0.033	**	0.095	0.317		-0.153	0.042	***
D75-80	-0.312	0.074	***	-0.156	0.047	***	0.330	0.354		-0.234	0.049	***
D80-85	-0.423	0.105	***	-0.199	0.064	**	-0.181	0.422		-0.316	0.059	***
D85-90	-0.452	0.118	***	-0.198	0.056	***	0.109	0.398		-0.328	0.063	***
D90-95	-0.491	0.135	***	-0.207	0.065	**	0.094	0.239		-0.347	0.070	***
D95-00	-0.619	0.156	***	-0.298	0.067	***	0.369	0.241		-0.454	0.075	***
D00-05	-0.654	0.167	***	-0.298	0.070	***	0.036	0.213		-0.477	0.082	***
Constant	-1.194	1.152		-0.068	0.170		0.588	0.332	+	-0.535	0.295	+
Rho	0.584			0.141						0.608		
Obs	435			435			435			435		
Countries	74			74			74			74		
R2 within	0.331			0.303			0					
R2 between	0.014			0.321			0.560					
R2 overall	0.086			0.287			0.030					

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Results are largely confirmed. In the between estimation only wages are significant and negative. In the other three models, lagged manufacturing share is always highly significant and negative. Exports shares are significant and take the expected positive sign. The undervaluation index is positive and significant in all estimations, except for the random effect model. In contrast to the previous findings, the coefficient of wages is significant and positive in fixed effects and Hausman and Taylor estimations. As in Table 2, time dummies are always significant and negative. Their increasingly low coefficients confirm that industrialising is becoming more demanding over time.

6 Conclusions

Since the early economic development theories, manufacturing has been considered an engine of economic growth and socio-economic development. In 1977, John Cornwall proposed a model of the role of manufacturing in economic growth. This model is composed of two equations: the first explains manufacturing output growth; the second explains aggregate growth as a function of manufacturing output growth. This model was referred to as the model of the engine of growth hypothesis. Empirical studies estimated the reduced form of this model and confirmed that manufacturing is an engine of economic growth (Kaldor, 1967; UN, 1970; Cripps and Tarling, 1975). Even in more recent years, and despite the increasing role of modern services, econometric studies confirmed that manufacturing is an engine of economic growth for developing countries (Fagerberg and Verspagen, 1999; Szirmai and Verspagen, 2015).

This chapter goes back to the Cornwall (1977) model and estimates a revised version of the first equation of the model, i.e. the equation of manufacturing output growth. The study puts industrialisation at the centre of the analysis and shows which variables instrument for manufacturing output growth in reduced form estimations of the engine of growth hypothesis. Understanding what are the drivers of industrialisation, and so why some countries industrialised and others did not, is important for the historic account of industrialisation, but also for the current policy discussions on catch up and industrialisation. We use a panel dataset that covers 74 between developed and developing countries from 1960 to 2005. We estimate Hausman and Taylor models and check the robustness of our results, applying alternative model specifications such as system GMM and mixed effects models.

The findings of this paper indicate that faster industrialisation occurs in countries with relatively underdeveloped manufacturing industries, large domestic markets, strong export performances, and undervalued exchange rates. These results confirm the abundant literature on the role of export and export promotion industrialisation strategies focusing especially on East Asia and with the empirical evidence and the theories on the role of the exchange rate (e.g. Rodrik 2008; Bresser-Pereira, 2008, 2012).

Price-related variables are only partly related to industrialisation: while exchange rates matter, labour costs do not seem to have the same importance. Indeed, labour costs are in most of the regressions positively and not significantly related to industrialisation.

When we look at how the behaviour of these determinants evolved over time, the results show that R&D expenditures and the measure of technological level developed by Fagerberg (1988) which combines patent and R&D expenditures are both significant determinants of industrialisation but only from the 1990s. Fagerberg and Verspagen (1999) also investigated the role of manufacturing as an engine of growth in the 1970s and 1980s and found a positive but not significant coefficient of R&D expenditures. We interpret our results as an additional evidence that industrialisation increasingly requires skills and technological capabilities.

Taken together, results on price-related variables and innovation-related variables at least partly confirm the Schumpeterian-evolutionary idea that industrial and international competitiveness are increasingly based on knowledge rather than prices. These higher requirements in terms of knowledge and skills make industrialisation more difficult to achieve, by requiring countries to invest in learning since the early phases of their industrialisation.

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Appendix 1.

Table 8. Details and source of variables

Variable	Details	Source
Industrialization	First difference of share of manufacturing in GDP	Szirmai and Verspagen (2015)
Income relative to US (RELUS)	GDP per capita as a percentage of US GDP, first year of the period	Szirmai and Verspagen (2015)
Size of the market (POP)	Logarithm of the population, first year of the period	Szirmai and Verspagen (2015)
Wages (WAGE)	Logarithm of total wages and salaries (at current prices) in the manufacturing industry divided by number of persons engaged and number of employees, first year of the period	INDSTAT2 2011 ISIC Rev.3
Merchandise exports (EXP)	Merchandise exports (current dollars) as percentage of GDP	Lavopa and Szirmai (2011)
Undervaluation index (UNDERVAL)	Real exchange rate adjusted for the Balassa-Samuelson effect, 5-year averages	Szirmai and Verspagen (2015)
Terms of trade (TOT)	Logarithm of terms of trade (2005 constant prices), 5-year averages	PWT 7.0
Inflation (INFL)	Logarithm of inflation rate, 5-year averages	WDI and IMF WEO[6]
Human capital (EDU)	Average years of schooling for the population above 15 years of age, first year of the period	Szirmai and Verspagen (2015)[7]
Institutions (DEM)	Vanhanen index, first year of the period	Quality of Government Dataset
Geography (KGATEMP)	Dummy variable percentage of land in a temperate climatic zone, transformed in a binary variable (KGATEMP)	Szirmai and Verspagen (2015)
Patents per capita	Number of patents per capita at USPTO (PATPC), first year of the period (normalised)	USPTO
	Number of patent per capita at national offices granted to residents (NATPATPC), first year of the period (normalised)	WIPO[8]
R&D expenditures (R&D)	R&D expenditures as a percentage of GDP, first year of the period (normalised)	CANA database (Castellacci and Natera, 2011)[9]

[6] For Chile and the UK, gaps were filled in with national data sources (Banco Centrale de Chile and Office of National Statistics respectively).
[7] Data are taken from Barro and Lee (2010).
[8] WIPO data start in 1965 and do not include some countries among which Taiwan.
[9] Data on R&D expenditures for Taiwan and Korea were retrieved from other sources (for Korea: Lim (1995), table 5; OECD; and for Taiwan: Smith (2000), table 2.12; NSC Indicators of Science and Technology).

Table 9. Countries in the sample

Country	Period	Country	Period
Argentina	1980-2005	Jordan	1970-2005
Australia	1960-1995	Kenya	1965-2005
Austria	1960-2005	Korea	1965-2005
Bangladesh	1980-2000	Luxembourg	2000-2005
Belgium	1960-2005	Malawi	1970-2005
Belize	1990-1995	Malaysia	1965-2005
Bolivia	1970-2005	Malta	1970-1995
Botswana	1980-2005	Mauritius	1980-2005
Brazil	1990-2005	Mexico	1980-2005
Cambodia	1995-2005	Morocco	1975-2005
Canada	1960-2005	Netherlands	1960-2005
Chile	1960-2005	Norway	1960-2005
China	1975-1990; 2000-2005	Panama	1960-1970; 1985-2005
Colombia	1960-2005	Paraguay	2000-2005
Costa Rica	1960-1970; 1980-2005	Peru	1980-2005
Cote d'Ivoire	1965-1985; 1990-2000	Philippines	1960-2005
Cyprus	1980-2000	Portugal	1995-2005
Denmark	1960-2005	South Africa	1960-2005
Dominican Republic	1960-1990	Spain	1960-1970
Ecuador	1960-2005	Sri Lanka	1965-1970; 1980-2005
Egypt	1980-2005	Sudan	1970-1975; 2000-2005
El Salvador	1965-2000	Sweden	1960-1995
Eritrea	1995-2005	Syrian Arab Republic	1965-1970; 2000-2005
Ethiopia	2000-2005	Taiwan	1970-2000
Finland	1960-2005	Tanzania	1965-1970; 1995-2005
France	1975-2005	Thailand	1965-2005
Germany	1970-2005	Trinidad and Tobago	1965-1970; 1990-2005
Ghana	1965-2005	Tunisia	1970-1985; 1995-2005
Guatemala	1965-2000	Turkey	1960-2005
Honduras	1960-2000	Uganda	1970-1975; 1980-2005
India	1960-2005	United Kingdom	1960-2005
Indonesia	1970-2005	Uruguay	1965-1970; 1985-2005
Ireland	1960-1980	USA	1960-2005
Israel	1960-2005	Venezuela	1960-2000
Italy	1965-2005	Vietnam	1995-2005
Jamaica	1965-1970; 1995-2005	Zambia	1990-1995
Japan	1960-2005		

Appendix 2

In order to check whether the results on institutional variables crucially depend on the selected measure of institutions, we test three alternative measures of institutions (Table 10). The first two come from the Polity IV dataset (Marshall and Jaggers, 2002) and are the democracy index and the measure of constraint on the executive, one of the components of the democracy index. The third is the index of political credibility by Henisz (2000, 2002). It measures the feasibility of policy change, i.e. the extent to which a change in the preferences of any one political actor may lead to a change in government policy. It goes from 0 to 1, with higher scores associated with less feasibility of policy change. As in previous estimations, the exogeneity of these variables is checked by means of Hausman tests. The Polity measure of political constraint is the only endogenous variable.

Table 10. Alternative indicators of institutions

	Polity Democracy			**Polity Constraint**			**Henisz index**		
	coef	se	sig	coef	se	sig	coef	se	sig
manL1	-0.334	0.034	***	-0.333	0.033	***	-0.340	0.033	***
lnpop	1.467	0.587	*	1.386	0.543	*	1.202	0.547	*
lnunderval	1.893	0.574	***	1.761	0.562	**	1.987	0.567	***
relus	-1.846	2.322		-1.886	2.248		-2.489	2.252	
wage	0.332	0.317		0.277	0.302		0.269	0.305	
export	8.153	1.799	***	7.991	1.771	***	7.904	1.802	***
edu	0.365	0.211	+	0.350	0.200	+	0.359	0.212	+
patents	-2.085	7.445		-2.263	7.331		-0.169	7.489	
inflation	0.238	0.169		0.227	0.160		0.266	0.161	+
terms of trade	3.594	2.110	+	3.172	2.049		3.578	2.080	+
democracy	-0.029	0.064		0.012	0.009		0.343	0.890	
kgatemp	0.895	1.579		0.766	1.412		1.450	1.547	
Constant	-10.245	6.000	+	-9.158	5.587		-7.351	5.568	
Rho		0.845			0.804			0.848	
Obs		420			429			435	
Countries		71			71			74	

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Notes: Period dummies are included but not reported.

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